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II. *Description of the Cydippe Pomiformis mihi,* (*Beroë Ovatus,* Flem.) *with Notice of an apparently undescribed Species of Bolina, also found on the Coast of Ireland.* *By* Robert Patterson, Esq., *Member of the Natural History Society of Belfast.*

Read 10th December, 1838.

IT is proposed to give in the present paper some account of the appearance, organization, economy, and habits of a Beroë, not uncommon on our Irish coast, in the hope that such details may prove interesting with regard to the species described, and may be of some value as illustrative of the family to which it belongs.

These observations were commenced in the month of May, 1835, at which time I resided in the immediate vicinity of the small sea-port town of Larne, in the County of Antrim. My lodging was situated on the small peninsula termed the Corran,* and nearly midway between the two stations, whence ferry-boats ply to the opposite peninsula of Island Magee. Through the narrow channel, across which these boats are continually plying, the tide runs with great rapidity into Larne Lough. Hence I had, by means of the ferry-boats, an easy mode of taking, at all hours during the day, the small *Medusæ* and *Crustacea,* which the flow of the tide placed within reach of a small canvass towing net. As the Beroës could thus with facility be procured, and were to me highly attractive, my sitting-room, for between two and three weeks, was never without some of them. They were kept in glass jars, the water in which was changed twice each day. The particulars which I then observed, were published in the Edinburgh New Philosophical Journal for January, 1836, and reasons adduced for regarding the species as distinct from the Beroë Pileus, the only tentaculated Beroë then regarded as British.

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* This word in the Irish language signifies "Reaping Hook," to which implement the little peninsula has a striking resemblance in form.

The ensuing summer I again visited the same locality, and had the pleasure of taking a Beroë similar in size to the one formerly described, but exhibiting very conspicuously an arrangement of whitish coloured vessels, which had their origin near the lower part of the stomach, and branched off to the several bands of cilia, one vessel running out to each band, and joining it not very far from the centre.

On the 24th of June, 1837, I was again at the Corran, and succeeded not only in taking three Beroës, exhibiting this singular structure, but with the assistance of a friend was enabled to have it delineated. These drawings were unfortunately mislaid before any more finished representation could be executed.

On the 8th of the next month, in Strangford Lough, I again took an individual of the same description, but the circumstances under which I was then placed, prevented its being subjected to any critical examination.

Its occurrence on so many different occasions excited the hope that it would again be met with; and when at the beginning of June, 1838, I returned to my former lodgings at the Corran, I felt desirous of being able to observe its peculiarities, and ascertain its species. This desire was augmented by a careful perusal of Doctor Fleming's paper, read before the Wernerian Society of Edinburgh 18th November, 1820, in which he describes a Beroë, subsequently designated, in his History of Bristish Animals, *B. ovatus.* This animal appeared to be furnished with vessels similar to those I had observed, but it differed from mine in being destitute of tentacula. The following is an extract from Dr. Fleming's description:

" The tube which conducts from the mouth to the centre of the body, and is prolonged in its axis to the summit, had on each side a compressed organ adhering to its walls. These terminated in the centre, each in an ovate head, apparently containing air. Immediately below each head, there were numerous twisted vessels, some of which contained a reddish fluid. The tube which descended from the summit, as it approached the centre, suddenly expanded, and sent off a branch to a vesicle on each side, after which it appeared to unite with the one from the mouth. Each of the lateral vesicles terminated below in a blind cavity, which contained a glandular body, to the upper surface of which several white threads were attached. The upper extremity of each vesicle was open, and terminated on the surface on each side, in the space between two ribs.

From each side of the vesicle, near its connexion with the central vessel, there arose a tube, which after dividing, sent a branch to each contiguous rib. The cavity of these tubes, at their union with the ribs, appeared to be filled with a whitish coloured pulp. Each rib is furnished with a tube uniting with it near the middle. In consequence of this peculiar structure, I could easily observe the water enter the tube at the summit, pass into the lateral vesicles, and go out at their external openings; and in some cases the motion of the current was reversed."

On the 10th of June, 1838, I had an opportunity, for the first time, of examining, under a lens, one of the Beroës exhibiting the peculiar ramiform structure already noticed. The animal was lying, like that observed by Dr. Fleming, with the mouth downwards, and evidently in an exhausted state. To my great satisfaction I observed the particles of fluid in motion, nearly in the manner that author has described, and in the vessels close to the stomach could observe there were two currents flowing in opposite directions. The same was visible in the whitish coloured vessels, going out to the bands of cilia. It was not apparent in the "lateral vesicles," they were filled with water, which moved at times backwards and forwards, but did not exhibit the active and continuous current presented by the other parts. That water issued from them was, however, obvious, by the effect visible on the fluid adjoining the terminal aperture, and exterior to the body of the animal. While examining one of the "glandular" bodies, I noticed that it did not always retain the same appearance, but was capable of expansion and contraction, and that on one occasion it was extended almost to the surface of the animal, moving within one of the "lateral vesicles," and approaching its external orifice. I waited in hopes that both of these "glandular" bodies would be still more fully thrown out, and would prove to be tentacula; but the inertness of the animal prevented at that time the fulfilment of my expectation. Next morning another Beroë was taken, vigorous and perfectly uninjured, and with the whitish ramiform vessels equally conspicuous as in the previous specimen. In the course of a few minutes it unfolded to my view its graceful and ever varying tentacula, furnished with delicate filaments, and exhibiting a ceaseless variety of outline.

The presence of the tentacula removes the animal from the genus Beroë of Fleming to the Pleurobrachia of the same author. His inaccuracy in the present instance was occasioned by his description having been drawn up from an examination of a single individual, "found in the Frith of Tay, in a pool left by the tide." The animal was then in an exhausted state, when the tentacula would naturally be retracted within the body. Dr. Fleming referred this species doubtfully to the ovata of Baster, but as they form not only distinct species, but belong to different genera, it is necessary to substitute another appellation, and as such I propose "Pomiformis."

Lesson, in his paper "Sur les Beroides,"* conjectures that the Beroë described by Fleming, might eventually be found, as is now the case, to belong to those bearing tentacula. The words in which this idea is expressed are the following:—"Peut-etre est ce au Cydippe globuleux qu'appartient l'espece trouvée par le Dr. Fleming (Mem. Soc. Wer. t. iii. p. 400,) dans le detroit de Tay, et qui n'avait point de prolongemens."

Having ascertained the identity of the Irish Beroë with that of Fleming, my next object was to have such drawings and descriptions prepared as would distinguish it from the species I had formerly described, and which in size and external appearance it precisely resembled. For this purpose I brought up with me in sea-water to Belfast, three of each, and hastened to a friend, to whose pencil I had been indebted on similar occasions. On my arrival it was found that the white radiating vessels of the C. Pomiformis, which had been so conspicuous when the animal was first taken, were scarcely perceptible. I took the earliest opportunity of procuring a further supply, but found that at the end of a few hours these distinguishing whitish coloured vessels were no longer visible. Knowing, however, their situation, I examined them under a lens, and though the vessels had lost their whiteness, saw in each the circulation of the fluid going on as usual. I then took eleven of the Beroës, in which no apparatus of the kind was conspicuous, and on subjecting them to a similar scrutiny, had the satisfaction of discovering that the same structure existed in all, and consequently that Dr. Fleming's Beroë, of the capture of which we have no record, save that of a single individual in 1820, was identical with that which I had taken so frequently, during successive years, at the entrance to Larne Lough.

In bringing together, under several heads, the observations made at various times on this Beroë, it is necessary to make frequent reference to its congener, the Pleurobrachia Pileus, Flem., Beroë Pileus of Lamarck, Cydippe Pileus Eschscholtz, Cydippe Globuleux, Blainville and Lesson, that the several points of accordance or of difference may be enumerated as the description proceeds. Dr. Grant's interesting and valuable paper " On the Nervous System of Beroë Pileus, Lam., and on the Structure of its Cilia,"* has rendered that species well known to naturalists, and furnished a standard, with which the one here recorded may with facility be compared.

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* Annales des Sciences Naturelles, tome v.

In size it is from two to nine lines in length, and about a third less in breadth. The general form is oval, but in some it is nearly globose, and in others flattened towards the poles, and similar in shape to an orange. The difference is to be attributed to a contractile power possessed by the animal, and not to any permanent diversity in form. The body is transparent and colourless, with the exception of the reddish coloured intestinal vessels noticed by Dr. Fleming, and which present a different aspect in different individuals.

The eight bands to which the cilia are attached extend about three-fourths of the distance from the mouth to the anus, but approach more nearly to the latter, and diminish in breadth towards either extremity. In C. Pileus there are about forty in each band; in C. Pomiformis the number in some individuals amounted only to fifteen, and in none which I observed did it exceed twenty-seven. Along each band a cord or slight ridge extends, dividing it longitudinally into two equal parts. The filaments on each band consist therefore of two parcels, which in general move simultaneously, although each portion possesses a separate and independent power of motion.

Dr. Grant remarks, that the cilia of C. Pileus are the largest he had yet met with in any animal, and states that "they are not single fibres, but consist of several short straight transparent filaments, placed parallel to each other in a single row, and connected together by the skin of the animal, like the rays supporting the fins of a fish. Viewed with the aid of a lens, the parallel fibres appeared like transparent tubes, sometimes a little detached from each other at their free extremities by injury done to the connecting membrane, and at these parts the isolated spines projected stiffly outwards. When the fins were quite entire, the membrane connected the tubular rays to their extremity, where the fin presented a slightly rounded outline."

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* Trans. Zool. Soc. vol. i. p. 9.

In C. Pomiformis the cilia present appearances very dissimilar to the above. In many individuals the filaments are not connected by any membrane, but appear numerous, flat, tapering, and slightly recurved towards the extremity. In others they are covered by a transparent membrane, divided as usual into two equal parts, and showing in each half but one or two divisions. They never exhibit an entire and unbroken surface, nor a continuous and regular margin. It was natural to suppose that a membranous covering might originally have existed in all, but had been abraded or torn, and thus caused the apparent diversity which the cilia exhibited in the number of their subdivisions; but this conjecture was shaken, by observing that specimens of less than the average size, and which might be presumed to be young, presented the same want of uniformity. The dissimilarity which prevails in this particular among different Beroës, will however be better estimated by a glance at the annexed figures, than by any detailed description.

The entire cilia, never for more than a moment remain perfectly at rest, unless when the animal is in a very exhausted state, and may hence be presumed to be organs of respiration as well as of locomotion. Sometimes, however, those of one or two continuous bands will vibrate, while all the remainder are still; or be at rest, while all the others are in motion. At times a slow vibration will commence at one extremity of a band, and pass along it, like the wave which can be impelled along an extended piece of cloth, or like the undulations of a fluid. Hence it is obvious that the Beroë can direct the aqueous currents which pass along the base of the cilia into any particular band, and can regulate at pleasure the velocity of their undulations. In the larger species, which I have named Bolina Hibernica, these currents are very conspicuous, and may be seen under* each band, one ascending, the other descending at the same time with great regularity.

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* The size of this ciliograde varies from little more than half an inch to nearly two inches diameter; its figure is diversiform, being nearly round, oval, or cylindrical, but most generally somewhat compressed. The lobes at each side of the mouth, at times very protuberant, giving to the animal a rudely cordate form, like the Mnemie de Schweiger. (Vid. Blainville, pl. 8, fig. 4.) The surface smooth.

There are eight rows of cilia, the alternate ones much shorter than the others. The cilia are

Dr. Sharpey remarks, "in the Beroë, and others of a similar form, the cilia* point towards the closed extremity of the body, so that the opposite or open end is carried forward." In the two species which have fallen under my observation, the cilia, when at rest, point not to the closed but to the open extremity of the body, and as they strike downwards towards the closed extremity, the animal is propelled forward in the contrary direction.

The tentacula of these animals were, next to the cilia, the most attractive parts of their organization. They were seldom displayed immediately after the

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detached, flexible, tapering, pointing upwards towards the mouth. At the upper extremity of each of the shorter bands is a circular orifice, with a ciliated margin. From each of these four apertures issues a singular aliform or auriform appendage; these are regarded by Mertens as tentacula covered with skin. Their appearance is extremely beautiful, both from their transparency and from the numerous minute delicate pointed cilia along their edges. Their aspect was ever changing. When first viewed they were pointed, erect, and hollowed longitudinally, so as to form a miniature representation of the ears of a horse. At other times they extended horizontally from the body of the animal, or were seen hanging loosely down like the ears of a lap-dog, or curved like the petals of the Martagon lily.

Between the 6th and the 18th of June, 1838, I took thirty-two specimens in a canvass towing-net, at the entrance to Larne Lough, County of Antrim. It had not fallen under my observation during any of the three previous summers, during which I had paid occasional visits to the same locality; nor was it met with after the date mentioned. On showing to Robert Ball, Esq. of Dublin, and William Thompson, Esq. of Belfast, several drawings of it taken from living specimens, I had the satisfaction of learning from these gentlemen its occurrence on other portions of the coast, it having been found by them at the island of Lambay, near Dublin, on the 1st of June, 1838, (or about the same time it was observed on the Antrim coast,) by Mr. Thompson in Strangford Lough, on the 3rd of July, (where it was in vain sought for by the writer on the 7th of August;) and by Mr. Ball a single specimen was taken at Youghal in June, 1837.

My object in making known, at the present time, its existence on the Irish coast, is to enable me to refer to it for the purpose of comparison and contrast with the C. Pomiformis. At a future period I hope to bring forward a detailed account of its structure and economy. Meantime I refer it, though with some doubt, to the genus Bolina of Mertens, (Mem. Acad. Imp. des Sciences St. Petersbourg, t. ii. p. 513,) established by him as a connecting link between the Callianyræ and the true Beroës; and as it has not been recorded as British—as it is distinct from the two species of Bolina described by Mertens—and is not noticed by any other continental writer, to whose works I have had access, I propose to give it provisionally the specific name Hibernica. If undescribed, this title will record the locality where it was at first observed; if already known, it will prove a convenient synonym, indicative of its occurrence on the Irish coast.

* Article "Cilia" in Cyclopædia of Anatomy and Physiology.

Beroës had been taken from the net, or while the glass vessel in which they were kept was crowded by the number it contained. When, however, not more than five or six were placed there, the tentacula were thrown out to their fullest extent, and were occasionally above six times the longest diameter of the body. In two instances they even exceeded these proportions; for a Beroë of less than five lines in diameter, exhibited them four inches in length, and one not exceeding six lines in diameter protruded them to the extent of five inches, as actually measured by a rule applied to the side of the glass vessel, from the top of which the tentacula extended downwards. Dr. Grant, in the paper already quoted, remarks,—"They extend from two curved tubes, placed near the sides of the stomach, which pass obliquely downwards and outwards, to terminate between two of the bands, at some distance above the mouth. * * * These tubes have a sigmoid form, and are shut and somewhat dilated at their upper extremity." In the Irish species the tubes are not curved in the form described, and their external orifice is at some distance, not from the mouth, but from the anus, agreeing in this particular with Blainville's description of their position.* The tentacula in both "consisted of two thin white filaments, round, and tapering to a very fine extremity." "Along their whole course they present," says Dr. Grant, "minute equidistant filaments, extending from their lower margin, which coil themselves up in a spiral manner, and adhere close to the tentacula, when they are about to be withdrawn into their sheaths or tubes." The filaments were in some individuals not less than half an inch in length, and of a delicate pinkish colour; and even so many as fifty may occasionally be reckoned on a single tentaculum. Most accurately has Dr. Grant remarked, "The tentacula are often thrown out from their tubes to their full extent by one impulse, and the slow uncoiling of the slender serpentine filaments from their margin, is then very beautiful; when coiled up they appeared like very minute tubercles along the side of the tentaculum." Of course, in particular points of view, they presented a moniliform appearance; and sometimes, while the filaments on the upper half of the tentaculum were seen under this aspect, those in the lower half were like delicate hairs or cilia, waving from the edge. In this respect, however, they were incessantly varying, and the tentacula, at the same time, were continually assuming new aspects, being retracted either separately or together, and thrown out in the same diversified manner. It is scarcely possible to convey, by any description, an idea of the beauty and diversity of their forms. They seem endued with exquisite sensibility, which, however, is not always equally delicate. At times the slightest touch will cause a tentaculum to be drawn back into its tube, with a sudden jerk; at other times it is apparently unfelt. The Beroës never seemed poised, or supported in the water by their tentacula. In one instance, however, they were extended to the bottom of the vessel, where they seemed to act as suckers, and formed fixed points, whence the animal rose and fell at pleasure, and appeared as if moored by these delicate and novel cables, the mouth being retained in the usual erect position.

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* Manuel d'Actinologie, p. 150.

What are the functions of these singular organs, is a natural inquiry. My friend, Robert Ball, Esq. of Dublin, states, that he regards them as organs of prehension. This is the view taken by Blainville, when he speaks of them as "servant pour attirer vers la bouche la proie qui s'y est attachée, probablement par une matière glutineuse."* Though unable to offer any more plausible conjecture, I cannot consider this opinion correct, as applied to the present species, as during all my observations I have never seen them thus employed, and from the comparative proximity of the orifices whence they issue to the anal extremity, the tentacula float behind the animal, and never approach the mouth, except at those times when the Beroë permits itself gradually to sink without reversing its previous position in the water.

"The mouth and œsophagus," as Dr. Grant remarks, "are wide; and the latter continues so to the stomach, which extends to the centre of the body. * * * There are four prominent membranous lobes placed around the mouth, which the animal can retract at pleasure." In the present species the appearance of four lobes arises from two membranous plates, which unite along their edges at either side, and are capable of being extended, so as to inclose an almost circular space. In general, however, they are so nearly together that they present very different appearances in different positions. The upper edge of each membrane is divided into two semi-circular lobes, and these are constantly varying, both in the extent to which they are protruded and that to which they are distended. It is seldom they are porrected to their full extent, but, when so, they produce so great a change in the oval form which the animal generally presents, that they make its outline appear like a miniature representation of one of those old fashioned bottles which we see in the pictures of the Flemish school.

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* Manuel, p. 151.

The only food I have ever been able to detect in the stomach has been small crustacea of different kinds. The first of these was an undescribed species, since named by my friend Robert Templeton, Esq. R. A., *Anomalocera Pattersonii.*[*] It was one line in length, and its bright green colour, contrasted beautifully, when in the stomach of the Beroë, with the crystalline transparency of the body, in which it was enclosed. In some instances two of these crustacea were visible in the stomach of one Beroë. The second I observed was a species of Zoea, on which Mr. Templeton also bestowed the specific appellation above mentioned.[†] Besides some other Zoea, I have distinguished some of the Gammaridæ. One of this family appeared to be half the length of the Beroë, and lay across the interior of the stomach, slightly bent, and when first observed was still living, and occasionally shifting its position. By a note in Trans. Ent. Society, vol. ii. p. 40, I learn that "M. Risso mentions his finding *phronima sedentaria* in the interior of a Beroë."

If, however, the Beroës feed upon small crustacea, they in turn furnish a supply of food to creatures more powerful than themselves. I have seen two of them swallowed by the Actinia Gemmacea,[‡] in the course of twenty minutes. Next morning portions of the bands of cilia and more solid parts of the Beroës were observed rolled together, and adhering, with some darkish coloured pellets, to the filaments of the Actinia, whence after some time they were thrown off. On another occasion I took a small Medusa of the genus Callirhoë, (of a species undescribed by Lamarck,) and placed in the glass vessel with it a Beroë, which had been taken at the same time. While the latter was swimming round the glass, with that lively and graceful movement for which it is so remarkable, it came in contact with the filiform tentacula attached to the arms of its companion. The arms instantly closed, and the Beroë was a prisoner. I endeavoured to separate them, and for this purpose moved them about, by pushing them with a a camel-hair pencil, but without effect. In about half an hour afterwards, when I again observed them, they were asunder, the Beroë swimming about, and the cilia of its bands vibrating as briskly as usual. It had not, however, escaped uninjured from its captor. The Callirhoë had taken from the body of the Beroë a portion which extended transversely across three of the bands, and longitudinally for about the one-third of its entire length. The being who had suffered this mutilation seemed, however, quite unconscious of its misfortune, moved about in every respect as before, and for four days, during which I afterwards kept it, seemed to possess all its powers in unimpaired activity.

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[*] Trans. Ent. Society, vol. ii. part 1, p. 34.

[†] Vol. ii. part 2, p. 114.

[‡] Johnston's Hist. Brit. Zoophytes, p. 214.

To this instance of apparent insensibility to pain may be added one illustrative of the extent to which the principle of vitality, or of vital irritability, seems diffused throughout every portion of its frame. On one occasion two Beroës were taken after a storm, with some of the cilia abraded, and other parts of the body shattered and even torn. Any of the cilia, however, which were attached to these mutilated parts, retained all their former mobility unimpaired. The most damaged of these Beroës was then cut with a pair of scissors into several pieces, and each part exhibited in its cilia the same undiminished rapidity of movement. One of these portions was again subdivided into parts so minute as to possess only one or two cilia on each, yet no change in the ceaseless motion of these extraordinary organs took place. Thirty-three hours after this minute subdivision, several of them were vibrating as usual; and, at the expiration of forty-two hours, the two cilia belonging to one fragment showed undiminished activity.

If a longitudinal incision be made in the body of a Beroë when dead, and the watery particles allowed gradually to evaporate, the bands of cilia and the tentacula will appear as if painted in a confused manner on the surface whereon the body has been placed, and when perfectly dry can be removed by a touch, as completely as if they had never formed a portion of animated existence.

Although, from this circumstance, it is obvious that the quantity of solid matter which enters into the composition of their bodies, must be extremely trifling, they possess a greater degree of firmness and consistency than is generally supposed. Frequently have some of them dropped from my net into the boat when about transferring them to the glass vessels in which they were kept; and, at such times, I have invariably lifted them in my fingers, and placed them with their companions, without their having received any apparent injury. If the finger be pressed against one recently dead, the Beroë will not, by such a pressure, be changed into a broken and shapeless mass. It will, on the contrary, by its smoothness and elasticity, slide from beneath the finger. In this respect it formed a singular contrast to the Bolina Hibernica, which could scarcely be removed without injury, and when taken in the hand appeared a shapeless mass of jelly. Some of the continental writers do not appear to have noticed this difference in the consistency of different Beroës, and have applied to the entire family, observations which are only correct when applied to particular species. Thus Lesson describes them as "peu consistant se brisant aisement à la moindre pression;"* and Blainville, under the genus Cydippe, introduces the observation of Othon Fabricius: "C'est un des plus jolis animaux qu'il soit possible de voir; mais aussi l'un des moins consistance, car à peine est il touché, qu'il est brisé et reduit en morceaux."†

From the inconsiderable quantity of solid material which enters into the body of the Beroës, and the rapid circulation of water, which is apparent throughout their frame, we would naturally suppose that any tinge which the body might accidentally acquire would be extremely fugitive. It was found, however, to be much less so than *a priori* would have been expected. My attention was drawn to this peculiarity by the circumstance of all my glass vessels being one evening occupied by Beroës and Crustacea, so as to compel me to place a small Medusa in a tin vessel, which chanced to be rusted at the seams. Next morning the colourless appearance of the animal was changed to a bright yellow, which appeared to pervade every part, and doubtless arose from the oxide of iron diffused through the sea water. This tint remained during the entire day, although the animal was transferred to pure sea water. Wishing to try if the vessels of the Beroë would become distinct, if filled with some coloured fluid, from which the animal could suddenly be withdrawn, and viewed through the usual transparent medium of sea water, I placed a Beroë in a weak infusion of saffron. At the end of twenty minutes its colour had undergone a perceptible change. I allowed it, however, to remain immersed for about six or seven hours, when it had assumed a bright yellow hue. It was then placed in pure sea water, but retained its yellow colour for twenty-four hours afterwards; and though it gradually became fainter, it was very perceptible even at the expiration of forty-eight hours.

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* Annales des Sciences, tome v. p. 236.

† Manuel, p. 151.

Lamarck observes, "Les Beroës sont tres-phosphoriques; ils brillent pendant la nuit, comme autant de lumières suspendues dans les eux; et leur clarté est d'autant plus vive que leurs movemens sont plus rapides."* Blainville, in his general remarks on the family of "les Ciliogrades," describes them as "agitant continuellement les cils dont leur corps très contractile est pourvu, organes qui jouissent les la faculté phosphorescente au plus haut degré;"† thus attributing the effect to the action of the cilia, rather than to any innate power possessed by the animal. That at least one British Beroë was endowed with a high degree of phosphorescence, was established by Dr. Macartney's description of B. Fulgens, taken by him in Hearne Bay, coast of Kent.‡ The same species was observed by the late John Templeton, Esq., "floating in with the waves on the shore of Dundrum Bay," County of Down.§ The phosphorescent quality does not, however, seem to prevail universally; at least I have never been able to detect its presence, though I have frequently for that purpose taken a glass containing Beroës into a darkened room. My hope of observing it was renewed by the following passage in a paper by Mr. F. D. Bennett,‖ "Fresh water appears to act as a powerful and permanent stimulus on marine Noctilucæ. Those which have intervals of repose from their phosphorescence, immediately emit their light when brought in contact with fresh water, and this fact was very strikingly exhibited in the Pyrosomata. * * * * When also the same Molluscs were mutilated, or so near death as to refuse to emit light upon irritation in sea water, immersing them in fresh water produced at least a temporary revival of their brightest gleam; indeed I have always felt assured that the contact of fresh water, in a darkened room, would ever elicit the luminous power of a marine creature, were the latter of a luminous nature." Acting on the suggestion here given, I took some Beroës into a darkened room, and transferred them to a jar of fresh water. No luminosity ensued; and hence if Mr. Bennett's inference be applicable to the Beroë, I may feel warranted in concluding that the C. Pomiformis is not possessed of any luminous property.

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* Animaux sans Vertebres, tome ii. p. 469.

† Manuel, p. 143.

‡ Phil. Trans. 1810, p. 264.

§ Mag. Nat. Hist. vol. ix. p. 303. In the same article the following occurs: "Beroë Mull. Pileus Gm. occasionally detected in our deep bays." We cannot from this brief record determine whether the C. Pileus or Pomiformis is the species alluded to.

‖ Proceedings Zool. Soc., June 13, 1837.

But although the experiment failed, so far as the object for which it was performed was concerned, it was not utterly fruitless, for it showed the effect produced on the Beroës by immersion in fresh water. The moment they came into contact with the fluid, the action of the cilia ceased, or was limited to two or three irregular strokes, and the animal sank, apparently lifeless, to the bottom of the jar. If instantly removed, and replaced in sea water, the cilia began again to vibrate, but had acquired a degree of opacity they had not previously possessed, and the entire body seemed in some degree contracted, and less transparent than before. If a Beroë be plunged into boiling water or alcohol, the instantaneous change from its ordinary diaphanous appearance is very conspicuous.

The ovaries in the specimen examined by Dr. Grant "consisted of two lengthened clusters of small spherical gemmules of a lively crimson colour, extending along the sides of the intestine and stomach." In above five hundred individuals of the present species, which I have had in different years the opportunity of observing, between May and October, these crimson gemmules were totally wanting. In the glass jars in which they were kept, a glutinous substance might occasionally be seen, in some cases in contact with the tentacula* of the animal. In it were numerous small bright transparent gemmules, which I thought might be ova. This conjecture was verified, by placing under the powerful microscope of my friend, Dr. J. L. Drummond, portions of the body of a Beroë, from which most of the watery particles had been evaporated. We then distinctly saw the colourless ova, which were similar to those I had formerly seen in the jars. On one occasion, in the glass vessels in which some specimens of B. Hibernica were kept, I observed two glutinous strings, one about three, and the other about five inches in length, and both containing numerous ova, ranged at irregular intervals, and sometimes disposed in clusters.

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* When treating of the genus Eucharis of Peron, to which the present species would belong, Lesson remarks, with a note of interrogation, "De ce retrécissement sur les côtés partent deux prolongemens cirrhigères, portant peut-être les ovaires?"—*Annales des Sciences Naturelles*, tome v. p. 252.

Dr. Grant, in speaking of the nervous system of C. Pileus, states, that he could perceive, at a short distance above the mouth, "a double transverse filament of a milky white colour, * * * * which formed a continuous circle round the body. In the middle of the space, however, between each of the bands of cilia, these cords presented a small knot or ganglion, so that there were eight ganglia in the course of this ring." Never having been able to observe these cords and ganglia in the C. Pomiformis, I took a number of specimens, some living and others recently dead, and placed them under the microscope already mentioned. But although Dr. Drummond, whose eye was well accustomed to microscopic examination, gave his valuable assistance, we were unsuccessful in detecting their presence.

A transparent membrane extends across a portion of the lower extremity of the body. It is entirely superficial, and may, perhaps, be of use in giving greater strength and stability to that part of the animal. This, however, is merely a conjecture, which I am at present unable to confirm or to correct by the opinion of others, as the membrane does not appear to have been noticed by any previous observer.

The Beroë is most usually described as swimming with its mouth downwards. Thus Blainville informs us, "Il nage peu obliquement, l'anus ou l'extrémite arrondie en haut, et trainant ses deux longs cirrhes comme deux queues."* Audouin and Milne Edwards, in like manner, state, "Il existe dans l'axe des Beroës une cavité qui va d'un pole à l'autre, et qui communique au-dehors à l'aide d'une ouverture inférieure, qu'on peut considerer comme l'avant bouche."† The words of Lesson convey a very different idea: "Dans l'eau leur position est très oblique ou presque horizontale."‡ It is with the mouth downwards that the C. Pileus is figured by Dr. Grant, and his description consequently bears reference to the animal as seen in that position. In this particular the C. Pomiformis is the reverse of its congener, the usual position of the mouth being uppermost, except when the animal is in a state of exhaustion, when it either rests on its mouth, or lies languidly on its side, at the bottom of the glass. At other times, when fresh and vigorous, its movements are lively, animated, varied, and incessant. Sometimes it is seen rising to the surface of the water with a slow and equable motion, like that of a balloon, then gradually descending, the mouth being retained in its usual erect position. Next ascending with rapidity, and turning the mouth downwards, or revolving on the transverse axis of the body; and then abandoning all these modes of progression, revolving on its longitudinal axis, the body being vertical, and in this position twirling round and round the vessel. When the movements of the body are thus varied, how great must be the variety of motion in the cilia by which the body is propelled!

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* Manuel, p. 150.

† Quoted by Lesson, Annales des Sciences, tome v. p. 240.

‡ Annales des Sciences, tome v. p. 237.

When the movements of the Beroës were thus diversified, it may be imagined they afforded highly pleasing objects for contemplation, especially as they displayed in the sunshine a splendid iridescence, caused by the action of the cilia in the water. To the various persons whom I met in the ferry-boats, plying between the Corran and Island Magee, their existence had been previously unknown. They seemed to be delighted no less by the novelty than by the beauty of their appearance, and not unfrequently compared the action of the cilia to that of the paddles of a steam-boat.

The C. Pomiformis, as now described, differs from the C. Pileus in the number and structure of its cilia, the position of the tentacula, the form of their sheaths, the want of colour in the ova, the inconspicuous structure of the nervous system, the existence of a transverse membrane at the anus, and the position in which the body is held when vigorous and unexhausted. I do not include in these distinctive characters the intestinal vessels which convey the fluid to the several bands of cilia, as it is possible that further investigation may prove that a somewhat similar arrangement prevails in both.*

When we contemplate the delicacy of structure displayed by the Beroës, we are prompted to inquire how they escape destruction from the turbulent element in which they live. On this subject Lesson remarks, "On doit supposer qu'ils augmentent leur pesanteur spécifique pour se précipiter à une certaine profondeur, là ou la mer est calme, et ou les lames sourdes, se font moins sentir."†

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* Nov. 22, 1838. I have this day, for the first time, had access to the observations and researches of Mertens on the Acalepha of the Beroë family, (Memoires de l'Acad. Imp. des Sciences de S. Petersbourg, tome ii. p. 479,) and am glad to find the above opinion confirmed by the authority of that author. In his illustrative plates, drawn from living specimens, the ramiform vessels going out to the bands of cilia are figured in several different species.

† Annales des Sciences, tome v. p. 243.

So far as their absence from the surface during stormy weather may be regarded as corroborative of this observation it is correct; but the procedure appears to be insufficient to defend them when near the coast from serious and often fatal injury. On this subject I would refer to the diary published by me in the Edinburgh New Philosophical Journal for January, 1836, as to the weather of the early part of May, 1835, considered in connexion with the number of Beroës taken at various intervals during the same period.

That they are more abundant in some seasons than in others, may be inferred from the fact, that in the beginning of May, 1835, I took, in crossing the ferry from the Corran to Island Magee and returning, so many as thirty-five. In the same locality, in the apparently more genial month of June, 1838, the greatest number I took in any one of twelve crossings, between the 5th and the 30th of that month, was seven. On the 10th of September, however, in the same year, and in the same place, I took the unusual number of forty-one. All of these were small in size, the largest not exceeding four lines in length.

Nearly a month later than this, I placed my net, &c. in the hands of my friend Mr. W. Thompson, who, in the prosecution of his researches into our marine productions, was going out for a day's dredging in the Belfast Lough. In the evening he gave me the unexpected pleasure of seeing nearly eighty Beroës, all of the present species, and rendered still more acceptable by the following note:

"The entire of these were taken between ten and half-past twelve o'clock this forenoon, the day being very calm and bright for the season; the wind easterly. The towing net was first placed in the water opposite to Holywood; about three quarters of an hour afterwards, near to Craig-a-vade, it was found to contain twenty specimens. In five minutes more thirty-six were taken, in the next ten minutes eight, and in another quarter of an hour fifteen."

The ensuing day, 6th October, my friend Mr. G. C. Hyndman, while engaged in similar pursuits, employed my net with even greater success, and in the same locality took nearly one hundred individuals, all of them similar to the above.

The present species appears to be extensively diffused around the Irish coast. It has been taken at the Giant's Causeway by Mr. Hyndman; in the Loughs of Larne, Belfast, and Strangford, by the author, as already mentioned; in the Bay of Dublin, outside of Kingstown Harbour,* and at Lambay Island, by Mr. Thompson and Mr. Ball, and by the latter gentleman at Youghal.

In conclusion it may be remarked, that the species now described combines the characters in Fleming's definition of the genus Beroë: "body with vertical ciliated ribs; tubular vessels traverse the axis of the body with lateral and terminal apertures;" and those in his genus Pleuro-brachia, "body sub-orbicular, with eight ciliated ribs and two ciliated arms, one on each side."

As it seems desirable to place under our view the distinctive characters of C. Pileus and Pomiformis, as detailed in the present paper, I subjoin a brief definition of each. They are the only British species at present referrible to the genus Cydippe of Eschscholtz.

C. Pileus.—Tentacula issuing near the mouth; cilia fin-like, with slightly rounded outline; ovaries crimson; nervous system, whitish cords, and ganglia.

C. Pomiformis.—Tentacula issuing near the anus; cilia divided; ovaries colourless; nervous system inconspicuous.

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* The specimens there captured were exhibited before the Natural History Section of the British Association in Dublin.—See 4th vol. of Reports, p. 72.

I am informed by Mr. Ball, that Mr. Bergin of Dublin has preserved some of these animals in a solution of acetate of alumina for fifteen months. In alcohol they have generally fallen to pieces in the course of a few weeks, or become so contracted as to be valueless as specimens.

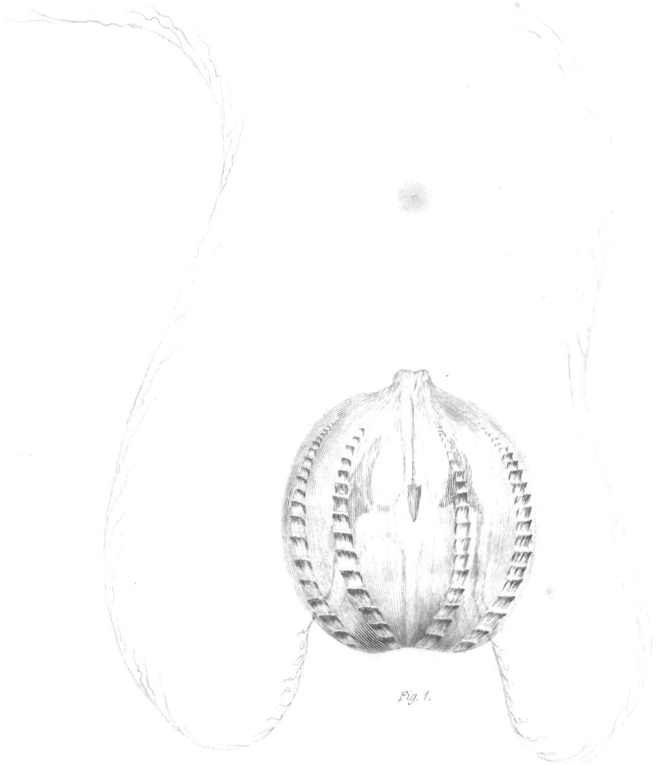

Fig. 1.

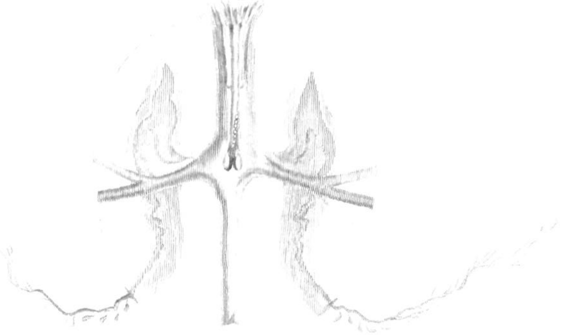

Fig. 2.

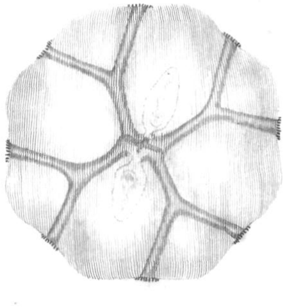

Fig. 3.

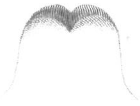

Fig. 5.

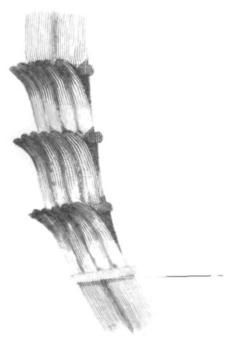

Fig. 6.

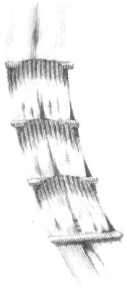

Fig. 7.

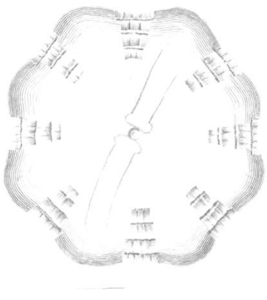

Fig. 4.

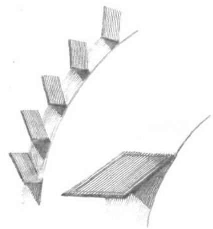

Fig. 8.

B. J. Clarke Del^t

J. Kirkwood Sc.

EXPLANATION OF THE PLATE

ILLUSTRATIVE OF THE APPEARANCE AND STRUCTURE OF CYDIPPE POMIFORMIS.

Fig. 1.—Magnified representation of this Beroë in the act of revolving on the longitudinal axis of the body.

2.—Internal structure, exhibiting the form and position of the sheaths of the tentacula, and arrangement of the ramiform vessels communicating with the several bands of cilia.

3.—The same vessels as viewed vertically; the dotted figures mark the outline presented in this position by the sheaths of the tentacula.

4.—Anal extremity of the body, with the transverse transparent membrane, and part of the several bands of cilia.

5.—Membranous lobes surrounding the mouth.

6.—Cilia represented in motion.

7.—Cilia of another individual when at rest.

8.—Cilia of C. Pileus; copied, for comparison, from the Zoological Transactions, vol. i. plate 2.

For the original drawings, which are taken from living specimens, I am indebted to the kindness of my relative, B. J. Clarke, Esq. of La Bergerie, Portarlington, with whom I had the pleasure of repeating many of the observations recorded in the present paper.

The Beroë is represented of about three times its natural diameter.